Northwest Fisheries Science Center

Research Highlights

from the Puget Sound Ecosystem

2009

NOAA FISHERIES SERVICE

NWFSC's Puget Sound Ecosystem Science is supporting whole ecosystem approaches to management in several important ways:

- Synthesizing "what we know" about the Puget Sound ecosystem for scientists and managers,
- Conducting as integrated ecosystem assessment (IEA),
- Valuing ecosystem services in Puget Sound, and
- Evaluating recovery strategies for endangered and threatened salmonid fishes and orca whales

The Puget Sound ecosystem ranges from snow-fed watersheds draining the Cascade and Olympic mountain ranges to the depths of Puget Sound marine waters through the Strait of Juan de Fuca to the Pacific Ocean. Home to the majority of the state of Washington's population, its health and beauty are integral to human health and well-being. The NWFSC, working with a variety of collaborators, provides key scientific information about the Puget Sound ecosystem and its health to support the Puget Sound Partnership and other management efforts.

Synthesizing 'what we know' about the Puget Sound ecosystem

NWFSC scientists collaborated with scientists from federal, state, tribal, local government, academic and non-profit entities to develop a comprehensive description of the Puget Sound climatic and physical processes, marine habitats, marine food webs and impacts of future ecosystem change. This collaboration identified indicators of degradation in Puget Sound such listed species, a disrupted food web, diminishing habitats, and persistent and toxic contaminants, and identified preventative strategies as one of the most ecologically sound and cost effective solutions for the future. While change is an inherent feature of any ecosystem, the projected changes in climate, population growth, and the complexity of the Puget Sound ecosystem all point to the need for an ecosystemwide view, integrating the human and natural systems of Puget Sound to improve our ability to choose cost-effective actions and predict long term results. Finally, connections between scientists and decision makers are considered to be crucial in achieving a broader perspective and sustainable strategy for the future of Puget Sound.

Conducting an Integrated Ecosystem Assessment (IEA)

An IEA is a quantitative analytical framework that provides support for ecosystem-scale management. It includes the following steps: identify indicators of ecosystem function, assess risk to those indicators individually and collectively, evaluate management strategies to address risks, assess performance through a monitoring and evaluation plan, and identify adaptation strategies as needed. A team of scientists is working towards the goal of completing the first iteration of an IEA for Puget Sound in 3 years. In the first year (2008), we developed several pieces of the IEA analytical framework:

- A marine food web trophic model (EcoPath with EcoSim) for Central Puget Sound that will be part of the core biophysical ecosystem model for the marine system,
- Preliminary analyses of which indicators best capture attributes of marine system condition (attributes such as resilience, trophic structure, food web stability, etc.),
- Two modules quantifying the effects of strategies on system indicators: (1) hydrology/land use scenario modeling exploring the effects of land use practices on fresh water yields and PCB loadings to the marine environment, and (2) models quantifying the effects of protection or restoration of nearshore eelgrass habitats on a suite of ecosystem services (see back page).

Learn more & come see us in action

Sharing our work with other scientists, with policymakers, and with the public is important to us. To learn more about what we do, please visit our website at: www.nwfsc.noaa.gov.

To arrange a visit or obtain additional information, please call 206-860-3200.

In the second year of the IEA, we are focusing on generalizing the marine food web model and linking it to oceanography, extending the watershed and nearshore models to include additional management strategies and output indicators for evaluation, and continuing to use quantitative modeling approaches to identify indicators of system response. By the end of our third year, the watershed, nearshore, and marine modules of the IEA will be quantitatively linked so that the cumulative effects of alternative strategies on indicators can be assessed.

Estimating ecosystem services

Ecosystem services are the benefits that humans derive from ecosystems. We are developing quantitative models estimating how changes in nearshore systems result in changes in the services provided. As baseline information for current provisioning of ecosystem services, we have summarized the magnitude of and spatial variation in species-specific biomass and revenues from fishery landings, human-induced alterations to the shoreline and nearshore, and human access and recreation opportunities. We also have developed quantitative assessments of how changes in a key nearshore habitat type–eelgrass beds–will produce changes in food web provisioning of key species such as herring, Dungeness crab, and other species with which they interact, carbon sequestration, and phytoremediation potential for PCBs and PAHs. Tradeoffs among valued species such as herring and hake are apparent from these models. We have conducted estimates of the economic value of these services for fisheries, the relative costs of protecting v. restoring eelgrass, and the potential value of carbon sequestration in emerging markets. Next steps in this work are focused on making more explicit links between human activities (e.g., shoreline armoring and geoduck aquaculture) and nearshore habitat change, links between changes in nearshore habitats and patterns of human uses (e.g., beach visitation and other recreational activities), and opportunities for climate adaptation through shoreline stabilization services.

Evaluating recovery strategies for endangered and threatened species

Orca whales and three species of salmonids–Puget Sound Chinook, Hood Canal summer chum, and Puget Sound steelhead–are listed under the ESA in Puget Sound. Research supporting development and evaluation of protection and recovery strategies for these species is focused on:

- Understanding the factors limiting recovery of these species. For salmonids, this includes developing metapopulation models to evaluate the cumulative effects of hatchery, harvest, habitat, and climate changes on salmon population dynamics. For Southern resident killer whales (orcas) we are focused on the three primary factors cited for their listing: stress from boat traffic, high toxic body burdens of persistent organic pollutants, and reduction in quantity of their primary salmonid prey species.
- Evaluating the impacts of freshwater restoration strategies (e.g., dam removal, floodplain channel improvements) on salmon and their habitats
- Describing year-round distribution patterns of the orca and their population dynamics